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THE BETTER ADAPTATION OF EDUCATIONAL AND INVESTIGATIONAL EFFORT TO THE AGRICULTURAL SITUATION[1]

I

OUR subject takes us at once to the very heart of the agricultural college movement. A more important subject in relation to agricultural progress could hardly be stated.

In a single brief paper one can touch only a few of the outstanding phases of the question. Sometime before very long, let us hope that a thorough study will be made of agricultural research and education as now conducted in the land grant colleges. This should be done by persons who are familiar with the land grant education movement and who understand the needs of the country. These institutions have been operating about half a century, some of them longer. They have endeavored to adapt themselves to ever-changing conditions and demands. They have made countless changes in curriculum and in subjects of investigation, in response to pressure of the moment. The original legislative acts have been supplemented repeatedly. Conditions throughout the country are changing rapidly and now are vastly different than when the first laws were passed. Problems have multiplied. Numerous other agencies have been created to do work that relates more or less directly to the work of the land grant institutions. And we have learned much from experience.

Before we can satisfactorily answer the question as to how well agriculture is being served by its special institutions in all the states and what changes should be made, there should be a study of the basic laws, financial support, the physical plants, the personnel in service, policies, the results obtained, the industry itself and the difficulties, drawbacks and needs encountered by farmers; and there should be an effort to look into the future. The whole problem should be studied with the purpose of better fitting the work of the institutions to the needs of the times. This would mean the reduction of some phases of work, the elimination of other, and the magnification of some and the development of some new activities, all in the interest of better service to agriculture.

There is good precedent in the recent study of medical education financed by Rockefeller funds and

[1] Address of the retiring vice-president of Section O—Agriculture—the American Association for the Advancement of Science, Washington, December 31, 1924.

which has resulted in better methods in education in medicine. Another precedent is furnished by the present study of engineering education financed by Carnegie funds. A leader in the latter effort refers to the interest of engineering educators, in defining the educational functions of the engineering colleges, in articulating the curricula more effectively with the needs of the engineering profession and of industry on the one hand, and with the preparation and characteristics of our entering students on the other hand, and in securing accurate knowledge concerning the nature and extent of occupational demands for engineering graduates.

These precedents suggest the extent and the value of a similar study of agricultural research and education as conducted under federal laws, supplemented by state laws and supported by both federal and state funds. This study should yield as large benefits as either of the other two. Some would say larger benefits. The importance of having the study conducted by men who are competent has been mentioned. It is obvious that ample funds should be available and ample time should be allowed so that the work would not need to be done under pressure.

II

It is fortunate that the laws underlying and limiting the research and educational work of the agricultural colleges do not prevent the institutions from keeping pace with the needs of their special constituencies. The only limit is in the appropriations. In some states this is serious. In many states it is detrimental to best results.

III

We are entering the third great epoch in the history of American agriculture. Profound changes are taking place and without much notice from the public. The first epoch was characterized by diversified production for the farmer's own home and for limited nearby markets—within driving distance. This began when the Pilgrims landed on the shores of New England and had to cut away the trees to make room for their crops. The second epoch came with the development of long-distance transportation. It might be called the period of quantity production. The aim seemed to be to produce as much as possible. The newer agricultural sections in the west prospered—at least the people on those farms seemed to think they prospered. Their costs were low and they gave no consideration to the value of plant food. At the same time the older agricultural sections in the east languished. Their costs were not so low and they were forced to consider plant food because they purchased much of it. World prices prevailed. Agricultural products constituted about one half of the exports from this country. But the exports have been decreasing.

In 1880 40 per cent. of the wheat crop was exported. In 1900 30 per cent. was exported. In 1910 the exports were 11 per cent. of the crop. During and after the war the wheat area was increased 50 per cent. and exports went as high as 43 per cent. of the total crop in 1921. But in 1923 exports had dropped to 25 per cent. of the crop.

In 1900 10 per cent. of the corn crop was exported. In recent years the exports have varied between one half and five per cent. of the crop.

In 1880 52 per cent. of the cheese manufactured in this country was exported. In recent years the exports have been down to one or two per cent. of the output.

The part played by research and education during the epoch of quantity production is generally understood and appreciated. The workers, many of whom have passed on, are honored for their service. But some criticize them for increasing production. It is hardly more reasonable to say these faithful workers were responsible for the large surplus and the exports than it would be to say that firemen were responsible for the growth of cities. The fact is that there were economic reasons for the increase of production and for the growth of cities. The firemen prevented disasters which would have checked the growth of cities by utterly destroying certain sections with corresponding ruin for the unfortunate people who happened to live or work in the path of the flames. And the scientists in agricultural colleges and experiment stations likewise prevented disasters which would have checked the quantity of production by destroying certain crops or animals with corresponding ruin for the unfortunate farmers who happened to live in the section where the pest or the scourge occurred.

The older college workers well remember the time and effort and expenditures given to different diseases or insects that threatened to ruin completely great numbers of farmers if not controlled. The fire blight of apple was recognized as being serious about 1880; the potato scab about 1890; the wilt of cotton about 1899; the chestnut blight about 1906; the flag smut about 1919; the take-all about 1920; and the San Jose scale about 1880; the cotton boll weevil about 1890; the potato leaf hopper about 1915; the Japanese beetle about 1916; the European corn borer about 1918.

Many others could be mentioned, and the list could be doubled by adding animal diseases, soil problems and questions of management.

The experiment stations, under great pressure, have solved many such problems and are still at work

on many. Other similar problems will appear as the years pass. If the experiment stations and the colleges did not deal successfully with such problems as these, the people through their legislatures would take drastic action.

We are now entering the third epoch in the history of agriculture in America. It is to be characterized by good business methods and these include especially those practices which spell high-class permanent agriculture. Most investigators and teachers in the stations and colleges are well aware of the situation and of course this statement applies to the workers in the national department of agriculture. Occasionally, however, some one is found working in one of our institutions who is investigating or teaching in the past. He does not know of the profound changes that are going on. Really such a person is not engaged in agricultural work but in applied history, and he should be transferred to the history department, if they will take him.

The reasons why agriculture is changing from a period of quantity production, with a constant surplus and with world prices prevailing, to a period of good agricultural business are overwhelming. Here are a few of them:

(1) Land values have increased.
(2) Taxes have increased.
(3) Cost of farm labor has increased.
(4) Cost of building has increased.
(5) Cost of farm supplies has increased.
(6) Cost of transportation has increased.

Some of these increases have been very large; for example, increases of taxes, which are indicated by national disbursements. The national expenditures in 1880 were 268 million dollars and in 1920 they were 6,142 million dollars. In the same period of forty years the population a little more than doubled. The great increase of expenditures is only partly accounted for by the war. Omitting war expenditures, that item increased in far greater proportion than the increase of population.

(7) Attention now must be given to the value of plant food. The reserve in the soil is our capital. It is being seriously depleted. The value of plant food at market rates carried out of one state in the agricultural products shipped beyond the borders is about 30 million dollars annually.

(8) World prices will be kept as low as other countries can keep them. To do this they are exercising their best ingenuity and expending large sums of money to discover more scientific knowledge and to apply this to agricultural production. Most of us fail to realize the great progress that is being made in developing agricultural science in other countries.

(9) Our standard of living is higher than it used to be and it is capable of being further improved. Farmers will not and should not accept a lower standard of living than is allowed to other comparable groups or classes.

It seems that to any one who has faith in the future of our country the reasons just given must be convincing. Our agriculture must be put upon a better business basis. We must know the business side of it better and be guided more by business records. All the many factors going into the cost of production must be considered, even to the plant food that is taken away by the crop.

IV

Agriculture conducted on business principles, with a view to permanency and with due regard to the important relations between rural life and national life, will be characterized by five outstanding features or lines of progress. Research or education which does not serve directly or indirectly to strengthen one or more of these lines is below 100 per cent. efficient. It would be interesting to see percentage marks that would truly represent the worth of research efforts in the name of agriculture and now in progress, and with due allowance for a reasonable share of research work along fundamental lines which might apply in some unexpected way to the solution of agricultural problems in the future. And it would be equally interesting to see percentage marks representing the real worth of our various courses of instruction in agriculture.

The five essentials for the kind of agriculture we want to see and the kind we should encourage in every way possible are:

(1) Careful business methods.
(2) Maintenance of fertility.
(3) Good homes and surroundings.
(4) Fair legislation.
(5) Patriotic citizenship.

Careful business methods mean records of transactions and their proper interpretation. Conclusions can not be drawn from figures alone. The teacher asked Johnny this question, "There were nine little pigs in a pen. Five got through the fence. How many were left in the pen?" He promptly answered, "None." "Why, Johnny," she said, "you don't know subtraction." "Well, teacher," he answered, "you don't know little pigs." He must have been a pig club boy.

The records should show low cost of production and efficient marketing. And the farm records compared with official statistics and estimates should show balanced production—that is to say, due regard to what

others are doing elsewhere in this country and in other countries.

Complaint is sometimes made that research and instruction in agriculture are responsible for overproduction and low prices. This is an appeal for ignorance to which intelligent farmers never will respond. They know there can be no excess of knowledge in good agriculture. The chief purpose of land grant institutions insofar as production is concerned is not to increase production but to reduce the cost of production. And much more work needs to be done along this line.

Creditable progress has been made toward better marketing. Cooperation is increasing. The margin between producer and consumer is being reduced in some cases and to the advantage of both producer and consumer. Much more progress needs to be made along these lines. More problems need to be solved and more instruction in the fundamentals and practice of marketing and cooperation and all business transactions needs to be given.

The second point of emphasis is the maintenance of fertility. This seems to be the hardest problem of all. We are told how other natural resources have been wasted, notably natural gas. Due chiefly to indifference and greed there have been wasted in one gas field, according to Van Hise, about 70,000,000 cubic feet of gas daily for a period of years. This was equivalent to the daily loss of 10,000 barrels of petroleum. Authorities say we have wasted natural gas at the rate of 1,000,000,000 cubic feet daily. Now that natural gas is about gone these losses are being appreciated and they do not increase our respect for the supposedly intelligent and patriotic people who were responsible.

The losses of soil fertility are comparable with the losses of natural gas but are more serious. Substitutes will be found for other natural resources. Waterfalls, wind, tides, sunshine and other sources of heat and power will take the place of fuels that are being exhausted. Clay and cement products and perhaps aluminum and other materials can take the place of iron and wood. No substitute has been found for fertility. Shaler writes that areas in Kentucky not tilled to any considerable extent more than one hundred years can not be brought back to their original fertility in any foreseeable time. They "must return to the forested state and, in that condition, through the ages, slowly gather again the mantle of soil."

Van Hise writes:

> The surface layer of soil, manufactured by the processes of nature through millions of years, is the most precious natural resource of the nation. Of all our duties to our descendants that of maintaining the soil unimpaired in thickness and in richness is the most serious . . . the conservation of the natural resources of the country, if accomplished, will only be possible through education. The beneficent effects of the public land grant for education, even from the point of view of conservation, extend beyond possible computation.

How well are we in our institutions meeting this challenge? It would be a great benefit to us if some one like Dr. Van Hise could tell us to what extent we measure up to his high standard and how we might better our service.

Much could be said regarding the third point—good homes and surroundings. Good schools and active churches are included. This relates intimately to the standard of living which should be as high for the farmer as for any large industrial group. The average standard of living in the country should be as high as in the city.

Great leaders of agricultural thought are emphasizing that in many places the standard of living in the country should be raised and if farm incomes can not provide for this even with improved methods, then this is evidence that fundamental readjustments should be made. The situation is being helped through instruction in home economics and because of the growing conviction that rural children are entitled to as good school training as is given to urban children. And it is being helped by repeated emphasis by President Coolidge and other national leaders on the fact that education and religion are both vital to our national progress now as in the past.

The term "fair legislation" has special reference to agriculture. Experience shows that the public needs instruction along this line. A business man's first reaction to the proposition that there should be a farm loan law was likely to be that such a law would be special class legislation. When he was reminded that the farmer's turnover is low and the usual short term loans could not apply, then he saw the need and supported the measure. The whole subject of legislation in relation to agriculture including appropriations needs further study and many facts should be widely promulgated. A large proportion of legislative enactments affect agriculture directly or indirectly.

To conduct agricultural research and education with proper reference to the needs of the time requires ample financial support. But the necessary appropriations are very small in comparison with the financial returns and they are very, very small in comparison with expenditures made by the public voluntarily for items that are generally regarded as of trivial importance.

For example, the total annual income of all land grant institutions and all branches of work conducted

in these institutions is about one hundred million dollars, and this is about one tenth as much as was expended in a recent year in this country for candy or one eighth as much as was expended for cigarettes or one seventh as much as was expended for perfumery and cosmetics.

The federal appropriation for state experiment stations is about one and one third million dollars annually or almost the same amount of money as one manufacturing concern spends in one year for advertising in about thirty leading magazines and papers, one brand of soup. The federal appropriation of about six million dollars toward the support of extension work is almost the same amount as is paid for advertising the products of one automobile concern.

The amount of taxes is always important and the reduction of taxes is always desirable. But the fair distribution of the tax burden and the honest and efficient use of tax funds are still more important. These questions are now very prominent. More knowledge should be secured through research and the knowledge we have should be more widely distributed.

Patriotic citizenship is mentioned as the fifth requirement of the ideal permanent agriculture. This implies no criticism of farmers. The whole nation is subject to criticism when only half the voters come out to vote at a presidential election, but probably farmers are least at fault. The whole nation is subject to criticism in reference to law observance and here again probably farmers are least at fault. We need a revival of our spirit of patriotism and of our devotion to the ideals of the founders of our nation and we need to increase our genuine sympathy for our neighbor. Who can or will set a better example in these phases of good citizenship than the farmer?

V

With an increasing abundance of knowledge, whether gained through accident or painstaking research or from long practice, and with our great organizations for dispensing this knowledge, agriculture still will be handicapped until that knowledge which is most needed is accepted and put into use by rural people. No one thinks that all farmers should be college graduates nor that all business men should be college graduates, but sometimes we are asked, "How many farmers should be college graduates?" The question might be answered in this way: There should be as many college graduates in a given number of farmers having a given capital as are found in a similar group of business men having approximately the same total capital. Certainly there should be at least as many well-educated farmers in an average agricultural community as the number of well-educated doctors, lawyers, storekeepers, insurance agents and others who are dealing constantly with the farmers.

This nation wants to avoid peasantry. Men and women of the farm because of their equal ability should take places side by side with urban residents in public affairs and in the public service. In some states and localities this fine relationship already exists and in not a few cases the farmers are doing more than their fair share. In other places the opposite is true. No one should be disqualified simply because he is a farmer.

Only a few of the many adaptations of research and education to present agricultural problems and needs have been mentioned. Excellent progress has been made and much more needs to be done. Enough has been said to show the need of a thorough study of this whole question as was first recommended in this paper.

We must keep our faith in agriculture and strive always to bring it more near to the ideal permanent agriculture which will be as great a benefit to all the people as to the farmers themselves.

RAYMOND A. PEARSON,
IOWA STATE COLLEGE *President*

FUNDAMENTAL CONCEPTS IN PHYSICS IN THE LIGHT OF RECENT DISCOVERIES[1]

THE EIGHTEENTH CENTURY: THE CENTURY OF MATERIALISM

THE physical scientists of the eighteenth century were diligent discoverers in an unexplored field. The facts they established remain for the most part with us to-day, but the point of view has completely altered. The mental attitude of the eighteenth century scientist may be characterized as materialistic to a degree which is difficult to realize at the present time.

Most of us have been taught that the subject-matter of physics is twofold—matter and energy. That was the orthodox nineteenth century doctrine, but the attitude of the eighteenth century was different. The scientists of that day studied matter only. The concept of energy was not recognized. Forces of all kinds—gravitational, mechanical, electrical and magnetic—were regarded as properties of matter. The concept of force was strictly subordinate, secondary and auxiliary to that of matter.

Gravitation in fact, continued to be thus regarded

[1] Abstracts of a series of three public lectures at the Carnegie Institute of Technology on January 6, 7 and 8.

up to recent years, when Einstein suggested that it was not a property of matter at all, but a space property (of which more later); and electricity has now gone so far as to reverse its former relation and to claim matter as merely an electrical phenomenon.

The idea that all forces were to be regarded as properties of matter was supported by what was known as the doctrine of imponderables. The mechanical force exerted by moving bodies could be readily enough explained as a material property, arising from the inertia and impenetrability of the moving mass. Other forces, more obscure in their action, such as electrical attraction, were not to be so simply explained. To account for these forces the existence of various kinds of imponderable matter was assumed. These imponderables were believed to be kinds of matter as real as water or air, but of a density so small that it could not be measured. In this, there was nothing absurd to the eighteenth century. It was known that air had weight, but this fact had been ascertained not so very long before. Previous to the invention of the air pump it was supposed that air had no detectable weight, that it was an "imponderable." And so great a difference was found between the weight of air and that of the lightest known solid or liquid that it was natural to ask: "Why may there not be a class of bodies with a density as much less than air as air is lighter than cork?"

Such an imponderable fluid was postulated to account for the phenomena of heat. It was called caloric. All bodies were believed to contain caloric soaked up in their pores as a sponge holds water. And just as a sponge, though apparently dry on the surface, may yield water on squeezing, it was supposed that cold bodies, by squeezing, rubbing or hammering, had their capacity for holding caloric reduced and in consequence some of this imponderable fluid was brought to the surface where it might be recognized by the sense of touch.

The phenomena of light were similarly accounted for by supposing light to be constituted of exceedingly minute particles of matter emitted from luminous bodies. It was recognized that such emission of particles must eventually result in a diminution in weight of the body emitting the light. Failure to detect this was taken merely as an indication of the inconceivable minuteness of the corpuscles.

We consider it ultra-modern in these days to speak of stars dissolving into light. The principal difference, however, between the modern concept and that of the eighteenth century is in the philosophical point of view. The older concept was thoroughly materialistic; that of our day is the opposite.

The phenomena of electricity were likewise explained by the assumption of an electric fluid, or rather, two fluids, soaked up in matter just as caloric was supposed to be. An excess or deficiency of one or the other of these fluids disturbed the balance and gave rise to the phenomena of electrification.

A similar imponderable fluid or effluvium was supposed to be the cause of magnetic attraction. Writers of that period express wonder that this emanation from the magnet should be able to pass through a sheet of glass or a board, and affect a compass needle on the other side.

Such materialistic views made up the attitude of the eighteenth century toward the phenomena of nature.

To this statement we must now hasten to make an exception.

There was one of these forces, namely, what was called the "vital" force, which stood in a class by itself. While all the other forces were regarded materialistically this one force could not be so regarded. They all looked at it with a sort of superstitious awe. This matter was perhaps of more interest to chemists than to physicists, though there was then not so sharp a line of distinction drawn between them as now. In organic compounds and living tissues there was thought to be some force acting which could not be reproduced in a laboratory. It was believed that it was under the influence of this vital force that a plant was able to synthesize its carbohydrates and water from their elements. This theory was overthrown when Wöhler made the first synthesis of an organic substance, urea, which he obtained by heating ammonium cyanate. This, chronologically, occurred in the nineteenth century, in 1828, but scientifically the centuries overlap considerably.

The doctrine of a vital force died hard. In fact, it did not die at all—it emigrated. When many other organic syntheses had been achieved, and it was finally recognized that organic chemistry was only a complicated kind of inorganic chemistry, the doctrine of vital force retreated before the advancing frontier of knowledge into the less known regions beyond, namely, into the biological sciences. Here the complexity of phenomena was (and still is) so great that among the shadows of the virgin forest the vital force could still find a retreat. There are vitalists and mechanists among the biologists to-day; the controversy rages violently. I can not see anything in it but history repeating itself.

In this we may see a second characteristic of eighteenth century science: a tendency to relapse into the supernatural. Many of the scientific works of the time read more like religious homilies with illustrations from the physical sciences than treatises on natural philosophy.

As a third characteristic of the century I think we may mention a failure to lay emphasis upon the quantitative aspect of phenomena where it might naturally be expected by modern scientists. An instance of this was the curious phlogiston theory of combustion, which held sway for nearly the whole of the century until disproved by the experiments of Lavoisier with his balance. On this theory combustion was believed to be due to a certain substance called phlogiston, contained in all combustible bodies, and which could not be isolated on account of its great tendency to combine with air. Sheltered by matter, it might remain inactive; but if the matter were heated to a certain point some of the phlogiston was forced out and immediately combined with the air. The resulting heat forced out more phlogiston until the matter was completely calcined or burnt. The slightest quantitative consideration would have shown the inconsistency of this theory; but no emphasis seems to have been laid upon this point until Lavoisier's day.

THE NINETEENTH CENTURY: THE CENTURY OF CORRELATIONS

Looking back over the nineteenth century, as it is beginning now to fall into perspective, the principal accomplishment of the century may be said to have been the correlation of the inheritance received from the eighteenth century. This, it will be remembered, consisted of a number of isolated and distinct concepts—matter, heat, light, electricity, magnetism, and forces of various kinds—all such forces (except the so-called vital force) being regarded as properties of matter of some kind, ponderable or imponderable. The nineteenth century reduced these concepts to two: matter and a new concept, energy.

This was a large task, and took the whole century. In fact, it overlapped at both ends, beginning with Lavoisier and Davy in the eighteenth century, and extending well into the twentieth century before Einstein showed the correlation between inertia and energy.

A typical example of one of these correlations is the development of the theory of light. At the very beginning of the nineteenth century two kinds of invisible light were discovered, the ultra-violet, or chemical rays, and the ultra red, or heat rays. For a time these were considered as three separate entities; but gradually they were shown to have the same properties, obeying the same laws of reflection, refraction and polarization, and the three concepts gradually became regarded as one, ether-waves differing only in wave length. The last piece of experimental evidence for this correlation was obtained as late as 1907, when it was shown experimentally that the speed of travel of the visible and the ultra-violet rays was the same.

Another correlation, of the first magnitude in importance, was that between heat and work. This was begun, chronologically, in the last few years of the eighteenth century, by Davy and Rumford, but its complete development did not appear for nearly half a century. With this development two names are connected: those of Mayer and Joule. The result of this correlation was the introduction of a new concept, energy. This concept was built up out of the "imponderables" of the previous century, heat, light, electricity. This concept, from its fruitfulness and far-reaching consequences, became equal to that of matter in importance, and it is to be noted that it is definitely immaterial in its nature. The establishment of this concept marks a definite tendency away from the materialism of the previous century.

One of the corollaries of the doctrine of energy carries with it consequences of poetic grandeur. This is the principle of the dissipation of energy. According to this principle, the various forms of energy in the universe are continually suffering transformations from one form to another, but with a gradual accumulation in the form of heat, in which form all the energy of the universe is apparently destined to remain forever in a form unavailable for any practical use. The activity of the universe is thus doomed to end in stagnation. A way of escape from this conclusion was sought by a number of scientists (Maxwell, Arrhenius), but the first satisfactory solution came only with the twentieth century, when it was shown from considerations of statistical mechanics that the universe must be regarded as capable of indefinite self-perpetuation; that heat not only could, but actually did run up hill on a microscopic scale, and that it was only a question of time and probability for it to execute this miraculous feat on a scale of sensible size.

Another correlation, of the first importance from an engineering standpoint, was that between electricity and magnetism, due to the experiments of Oersted and Faraday.

With the correlation between electricity and light, shown by Maxwell, and experimentally demonstrated by Hertz, the scheme of correlations was almost complete. One important thing yet remained uncorrelated with any other physical fact, in spite of many and heroic attempts to bring this about: gravitation at the end of the century was just where Newton left it two hundred years before. The final correlation of gravitation with other phenomena was to be one of the principal contributions of the twentieth century to science.

A second great accomplishment of the nineteenth century was the establishing of the atomic concept of matter on a firm foundation. This concept was not new; Newton and Boyle had held it, to mention only two of the greater names. With the atomic theory the name of Dalton is usually connected. What did he do to warrant this? He did something characteristic of the nineteenth century: he made the concept quantitative; he introduced the idea of definite weights for the atoms of different materials, and introduced on this atomic basis the laws of definite and of multiple proportions into chemistry.

A further attempt at correlation was made by Prout early in the century, who suggested that the different atomic weights were all multiples of that of hydrogen. With the progress of exactitude in atomic weight determinations this was regarded as an untenable hypothesis; but the twentieth century has completely vindicated Prout.

For several years prior to 1895 a curious pessimism overspread the minds of physicists everywhere. It was widely believed that the great discoveries of physics had all been made, that the science of the future was to be a science of residuals, of farther decimal places, of second order effects. To this there was at least one honorable exception. Lodge, in his "Modern Views of Electricity," (1889) placed himself on record as a thorough optimist. He said:

> The present is an epoch of astounding activity in physical science. Progress is a thing of months or weeks, almost of days. The long line of isolated ripples of past discoveries seems blending into a mighty wave, on the crest of which one begins to discern some oncoming magnificent generalization. The suspense is becoming feverish, at times almost painful. One feels like a boy who has long been strumming on the silent keyboard of a deserted organ into the chest of which an unseen power begins to blow a vivifying breath. Astonished, he now finds that the touch of a finger elicits a responsive note, and he hesitates, half delighted, half affrighted, lest he be deafened by the chords it would seem he can now summon forth almost at will.

The nineteenth century may be said to have closed, scientifically speaking, with the year 1895, in which Roentgen discovered what he called "a new kind of light." With this discovery, followed quickly by that of radioactive bodies, the crest of the oncoming wave broke upon us. In the ensuing turmoil we are still struggling for a foothold. Some, Lodge (it must be confessed) among the number, are clutching desperately at straws; others of us, equally at a loss for a solid foothold, are swimming as best we can, awaiting the quieting of the sea, when a new and firmer footing will doubtless be found.

The general progress of the science of physics in the nineteenth century may be said to have been steadily away from the materialism of the eighteenth century. At the end, we find the two main concepts of physics, matter and energy, equally dividing the ground between materialism and its opposite.

THE CENTURY OF HOPE

Though the twentieth century is but one fourth past, we may notice three contributions of the first magnitude which it has already made to the science of physics: the electrical theory of matter (including the inertia of energy), the quantum theory and the theory of relativity.

The nineteenth century closed with rather vague ideas current as to the nature of electricity. While some regarded it as an independent entity of unknown nature, others supposed it to be a state or condition of the ether of space, and hence a form of energy, like light. In the closing years of the century our ideas regarding electricity began to trend rather definitely in a certain direction, namely, toward a correlation of electricity and matter.

The first step toward this was taken when it was recognized that a moving body, when given an electric charge, acted as though its mass had been increased in consequence of this charge; that is, that an electric charge in motion possessed inertia. The questions then arose: May not the whole mass of the body be thus explained? is not ordinary matter only an electrical phenomenon? There was the opposite possibility to consider: electricity might be only a state or condition of matter; but the early years of the twentieth century saw the triumph of the first idea. Matter became merely an electrical phenomenon.

The atom of matter is now regarded as a minute planetary system, with a central positive nucleus and a number of negative electrons circling round it. On this theory, due to Rutherford and Bohr, the nucleus of the atom is responsible for its mass-properties, and the number and arrangement of the circulating electrons for its chemical and physical properties. The accuracy with which this atomic model fits the facts is uncanny.

This subordinating of the concept of matter to that of electricity is a long step away from the materialism of the eighteenth century. Another equally long step was taken when it was shown that matter and energy were close akin. This doctrine, known by the name of the inertia of energy, was first announced by Einstein as a consequence of the principle of relativity, but he later showed that it was a hitherto unrecognized corollary to Maxwell's electromagnetic theory, than which there is nothing more classical. This theory states that energy, like matter,

possesses inertia; that when a glowing body cools off, emitting light and heat, it actually loses mass in the process.

This loss is very small, far too small to pick up experimentally on a laboratory scale; but in the case of bodies like our sun it may amount to a large figure. The energy radiated per second by the sun is enormous. Converted into its energy value it gives the rather surprising figure of four million tons per second! But so super-enormous is the sun's total mass to start with that he is good for this expenditure for something like ten million million years!

In this identification of the material concept of matter with the immaterial concept of energy we have taken another long step away from the eighteenth century position. In the light of this correlation of matter and energy it is but natural that the quantum concept should have arisen, for if matter is atomic and only an aspect of energy, then energy should be atomic also.

The quantum theory atomizes energy into indivisible units, and as a consequence explains several discrepancies that had previously existed between theory and experiment. Great as are its successes in this line it can not be regarded as the last word in the matter, for it is in contradiction with a considerable body of experimental fact which is still best explained by the classical theory. Perhaps the ultimate solution will be found in some broader concept of which the two opposing theories are special cases.

The theory of relativity will be treated here only so far as it is concerned with still another important correlation, that of gravitation with other physical phenomena.

At the beginning of the twentieth century gravitation was a great mystery. In spite of much experimenting and more theorizing, the phenomenon of gravitation stood apart, refusing to show any correlation to other phenomena. In the year 1900 our knowledge of gravitation was just where Newton had left it, two centuries before. It was left for Einstein to point out that which when once seen is never forgotten—the correlation of gravitation with inertia.

But great as are the coordinating and correlating properties of the theory of relativity, it can not be regarded as the last word in its line any more than can the quantum concept; for the theory of relativity begins to fail us when applied to rotating bodies. Here, as Eddington says, it stops explaining phenomena and begins explaining them away. It is, however, a great step in advance, and much of it will remain permanently in the theory of physics even when it shall be supplanted, as it must be, by some broader and better concept.

Where, then, has the progress of three centuries in physical science brought us? Of the many distinct concepts of the eighteenth century not one is left. The sole concept of modern physics, energy, was not known in the eighteenth century, and this concept is above all things immaterial. The theoretical structure of our science is left without material means of support. The twentieth century so far is a century of bewilderment. But it is young yet; may we not call it the century of hope? Who knows whither it will lead us?

PAUL R. HEYL

U. S. BUREAU OF STANDARDS

THOMAS LEONARD WATSON

DR. THOMAS LEONARD WATSON, Corcoran professor of geology at the University of Virginia from 1907 to the date of his death, head of the department of geology since 1910, and state geologist and director of the Virginia Geological Survey since 1908, died on November 10, 1924. He was born in Chatham, Pittsylvania County, Virginia, September 5, 1871, and was the descendant of an old and well-known Virginia family. His early education was obtained in the public schools of Pittsylvania County, and in 1890 he was graduated from Virginia Polytechnic Institute, Blacksburg, Virginia, at that time known as the Virginia Agricultural and Mechanical College. Chemistry was his chosen profession and, after a year's residence at the University of Virginia, he served as assistant chemist at the Virginia Experiment Station in Blacksburg, from 1891 to 1895, and at the same time was instructor in geology at his *alma mater*. During this later period of residence in Blacksburg, Dr. Watson became more deeply interested in geology, particularly on the chemical side. He perceived the great opportunity for service to his native state in the study of its natural resources and intricate geology, and accordingly resolved to forsake his allegiance to chemistry and devote his life to geology, with the hope of service to Virginia, a hope that was to be immeasurably fulfilled. Accordingly he entered Cornell University and received the doctorate in June, 1897, his thesis being on glacial geology, a branch of geology that he never afterwards pursued to any extent.

After leaving Cornell, Dr. Watson went to Georgia as assistant state geologist, where he remained until 1901, when he resigned to become professor of geology at Denison University. In 1904, he resigned the professorship at Denison to return to Virginia Polytechnic Institute as professor of geology, where he remained until 1907, when he was appointed professor of geology at the University of Virginia, and in 1908

was made director of the recently organized Virginia Geological Survey, positions which he filled with highest effectiveness until seized by a brief but fatal illness.

Notwithstanding his busy life, Dr. Watson found time to spend a part of the summer of 1897 with the Indiana Geological Survey, the summer of 1903 with the North Carolina Geological Survey, and parts of the years 1897 and 1898 in research work in the United States National Museum.

In 1899 Dr. Watson was married to Miss Adelaide Stephenson, of Atlanta, Georgia, a singularly happy union. Out of this union six children were born, all of whom, with Mrs. Watson, survive.

Dr. Watson was a man of high ideals. His life was devoted to public service and, while he was serving his state and his profession with great enthusiasm and tireless energy, he did not neglect the opportunity for public service in his community. He was a director of one of its banks for a considerable time and, for many years, was a member of the Charlottesville School Board. He was also an active member of the First Baptist Church.

Probably the greatest service which Dr. Watson rendered was to his state through the medium of the State Geological Survey. The splendid series of reports published by the Survey during his administration are of the highest usefulness and scientific value. They take first rank among scientific publications in this country and constitute a permanent memorial to the scientific spirit and enthusiastic energy of Dr. Watson as a geologist and administrative officer.

Dr. Watson was successful as a teacher. His scholarship, grace and courtesy easily and quickly won the admiration and devotion of his students. Many of his students have already made a notable record in geology and other phases of science.

His success as an investigator and productive scholar won universal recognition and many honors and placed him in the first rank of American geologists. He was the author of more than 150 publications, including coauthorship of the standard textbook on engineering geology. His writings were particularly in the field of economic geology, mineralogy and petrology, but he took a lively interest also in other phases of earth science and his contributions to those fields were on as high a plane of scientific excellence as in his specialty. Although only fifty-three years of age at the time of his death, he had accomplished a tremendous amount of work.

Dr. Watson was a member of the Sixth Peary Arctic Expedition to North Greenland, Fellow of the American Association for the Advancement of Science, Fellow of the Geological Society of America and the Mineralogical Society of America. He was a member of Sigma Xi, Society of Economic Geologists, American Institute of Mining Engineers, Seismological Society of America, Geological Society of Washington, Washington Academy of Science and the Association of State Geologists. He had served on many committees in connection with his various scientific activities and had held various offices in the scientific societies to which he belonged. During the later years of his life, he had been a member of the council of the Geological Society of America, secretary of the Association of State Geologists, and at the time of his death he was chairman of the committee of the Mineralogical Society of America on nomenclature and classification.

In the death of Dr. Thomas L. Watson, the state of Virginia loses one of its most valuable and effective public servants, the University of Virginia one of its most widely known scholars, and the science of geology one of its foremost exponents in this country.

ALBERT W. GILES

UNIVERSITY OF VIRGINIA

SCIENTIFIC EVENTS

THE PROPOSED INTERNATIONAL CONFERENCE ON FLOWER AND FRUIT STERILITY

THERE have already been held under the auspices of the Horticultural Society of New York two important conferences on matters of vital interest to horticulture. One conference in 1902 was on "Plant breeding and hybridization" and one in 1907 was on "Plant hardiness and acclimatization." The papers presented at these conferences were published by the society as volumes 1 and 2 of its memoirs.

For some time the officers of the society have had in mind the holding of another international conference on some subject of timely significance to the progress of horticulture. After careful consideration the council has decided that the subject of this conference be "Flower and fruit sterility." A conference committee consisting of N. L. Britton, *chairman;* Frederic R. Newbold, *treasurer,* and A. B. Stout, *secretary,* was appointed, the organization of advisory committees was authorized, and a sum of money appropriated for the expenses of the conference and for the publication of its proceedings.

A preliminary statement of the main features of the conference may be made at the present time as follows:

Scope: The conference will consider the phenomena of sterility and fertility in fruit and seed production with special reference to (a) the breeding of floricultural plants, (b) problems of fruit growing and seed production in horticultural and agricultural crops

and (c) the botanical and genetical aspects of sterility and fertility.

Character of the Sessions: It seems desirable to hold a three-day conference with one day devoted to the interests of floriculture, one to the problems of fruit growing and one to the more purely scientific aspects of the subject. There will be invitation papers of the symposium type with shorter and more special contributions as offered. It is planned to have invitation papers presented by several noted horticulturists, botanists and geneticists especially from Europe.

Time and Place: An International Conference on Plant Sciences is to be held at Ithaca, N. Y., in 1926, which will be attended by horticulturists, geneticists, plant physiologists and others who will also be interested in the work of the Conference on Flower and Fruit Sterility. For this reason it has been decided to hold the conference in New York City during the week of August 9 to 16, 1926. This will immediately precede the Ithaca conference, whose sessions are from August 16 to 23.

Further notices regarding this conference will be made from time to time. An effort will be made to reach all who are interested in the subject. The cooperation of all who are interested is requested. The committee is now ready to receive titles of papers and an early report from those who plan to attend and particularly from those who wish to present papers is requested.

A. B. STOUT, *Secretary,*
Conference Committee
598 MADISON AVENUE,
NEW YORK CITY

PLANS FOR THE NATIONAL MUSEUM OF ENGINEERING AND INDUSTRY

FEDERAL authorities have tentatively approved the proposed location for the $5,000,000 National Museum of Engineering and Industry, which it is planned to build within a few years in Washington, D. C. Under present plans the building, which will be five hundred feet in length and three stories in height, will be erected on land adjoining the Smithsonian Institution. The architect has just completed the preliminary drawings, which will be studied by the Fine Arts Commission. Final drawings, still to be made, must be completed before the commission gives its approval.

The museum will be the world's largest and finest, in its magnitude and completeness surpassing all Europe's industrial museums. The total floor area will be the equivalent of twenty-seven acres. This space will permit an impressive display of exhibits of engineering and the industries. Large corridors, a central rotunda, adequate administrative offices and conference chambers and halls for the conduct of public lecture work are embraced in the plans. Provision is made as well for ample storage space, workshops and shipping rooms below the ground level.

To perpetuate the names of those whose ingenuity, initiative and perseverance have advanced the material progress of civilization, the central rotunda will be designated "The National Hall of Fame for Engineers, Inventors and Industrialists." Therein will be installed busts and memorials of the great figures of industrial and engineering history. An adjoining chamber will be known as "The Founders' Room" and contain busts, tablets or other memorials, uniform in character, of those whose foresightedness and whose contributions in time, money and effort have made possible the successful establishment and maintenance of the museum.

Under the present plan the new building will replace existing buildings now used to house industrial exhibits. The museum will receive exhibit articles from all the numerous government departments for preservation. These sources include the United States Patent Office, the Bureau of Standards, the Department of Commerce and Labor, the War and Navy Departments and other governmental agencies connected with industrial and scientific research. Private individuals, societies and corporations will be invited to submit to the institution any or all objects within their keeping that are deemed to have historic or technical interest in depicting the onward course of industrial evolution. While the plans call for the founding of a chain of sectional branch museums in industrial centers throughout the country, the central museum here is expected to shape the course of their destinies, opening up facilities and services of nation-wide scope to each. Each branch museum may obtain from the Washington institution authentic copies of all specimens preserved here.

Two of the projected sectional museums are already under way. In New York, Henry T. Towne has bequeathed $1,000,000 toward the establishment of a "Museum of the Peaceful Arts." In Chicago, Julius Rosenwald has promised the first $1,000,000 toward the establishment of an industrial museum to represent the interests of that territory. Each of the local institutions is expected to specialize in those industries which are of dominant importance in their respective districts.

STATEMENT SENT TO THE PRESIDENT OF THE UNITED STATES BY THE ASSOCIATION OF STATES GEOLOGISTS

AT the annual meeting of the Association of American States Geologists held in Ithaca, New York, December 29 to 31, the following officers were elected

for 1925; President, Wilbur A. Nelson, state geologist of Tennessee; secretary, M. M. Leighton, state geologist of Illinois; member of executive committee, E. B. Mathews, state geologist of Maryland. The association voted to send a memorial to the President of the United States requesting a liberal support to scientific work. The memorial, which was presented by the new president of the association, follows:

The American Association of States Geologists is composed of state officials charged with the scientific study and exploration of the natural resources of their respective states. As such, they are engaged in the development of new taxable values; and in the outlining of policies along these lines for the different states in the union. They are therefore vitally interested in the policies adopted affecting the scientific work carried on by the federal government.

State geological surveys through the application of science in solving the problems of geology, particularly as they relate to the unknown or undeveloped resources of the country, are laying the foundation for the establishment of new mining developments and manufacturing industries; and often actually assist such industries in starting on a successful basis. The members of the association are interested in water power, stream gaging, mining, quarrying of structural materials and road materials, soils, topographic mapping, forestry, fish and game, parks, oil and gas, industrial and municipal water supplies and waste disposal. They are oftentimes the only state agency charged with scientific study, and development of these natural resources. Because of this there is a lively interest not only in geology and all allied sciences, but also the fundamental relation of scientific work to the prosperity and general welfare of our respective states and the country as a whole.

In connection with their various activities state geologists have occasion to come in contact with and to use all the scientific bureaus of the government and necessarily must depend on the government scientific bureaus for a great deal of service from their highly specialized and trained scientific personnel, which the smaller state organizations could not afford to maintain independently.

Without this help it would be impossible for us to render the quality of service which should be given to our states, and which is now being given in developing our varied resources.

As state geologists we feel that in the effort to secure economy, a false economy is likely to be inadvertently adopted by the government, which will actually retard the development of new taxable wealth.

The building of a scientific personnel of high quality is a matter that takes years. The destruction of the spirit of such organizations can be accomplished in a few months.

This scientific work of the federal government, the high value of which we keenly appreciate, lacks encouragement to such an extent that the best scientific ability possessed by the young men of the country is not being attracted into the government service as it formerly was; and further many of the best men at present in the service are impelled regretfully to seek occupation elsewhere.

We feel that this situation, while not keenly appreciated by the public, is one which has a vital bearing on the public welfare and that a grave mistake in public policy will be made if the present conditions are allowed to continue.

The maintenance of competent national scientific bureaus is not a matter of interest solely to national officials of the legislative and executive branches. It is also of vital interest to local state agencies throughout all the country. We would respectfully suggest that in preparing the budgetary distribution of funds for scientific work by the federal government the judgment of some impartial representative body of scientists, such as the National Research Council, established by executive order soon after the World War, might prove of service.

The fact that members of this association officially represent thirty-seven states of the union gives them a personal contact with the pulse of the thinking people on this subject. We, therefore, feel it our duty as public officials, and privilege as citizens, to present this matter to you and to respectfully urge that you give it careful and serious consideration.

Respectfully,

WILBUR A. NELSON,
President, Association of States Geologists of America

THE ELLA SACHS PLOTZ FOUNDATION FOR THE ADVANCEMENT OF SCIENTIFIC INVESTIGATION

THE Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation was established in 1923, and during the first year of its existence the trustees have received thirty-two applications for assistance from investigators in the United States, Europe and Australia. Grants were made in eight instances, as follows:

Dr. T. Addis and Mrs. L. L. Mackay, Leland Stanford University, $1,000 for an investigation of the factors which influence the rate of compensatory hypertrophy of the kidney after unilateral nephrectomy.

Dr. George E. Fahr, University of Minnesota, $500 for a research on the rôle of colloids of blood plasma in the production of edema in acute and subacute glomerulonephritis.

Dr. Frank Fremont-Smith, Harvard University, $1,000 for investigation of physiology and biology of spinal fluid.

Dr. Henry G. Barbour, University of Louisville, $1,500 for an investigation of the physiology, pharmacology and clinical pathology of water exchange.

Dr. A. Bezredka, Pasteur Institute, Paris, France, $1,500 for researches in bacteriology and immunology.

Dr. Joseph C. Aub, Harvard University, $1,000 for a study of the internal secretions of the adrenal cortex.

Dr. L. H. Newburgh, University of Michigan, $1,250 a year for three years for a study of the production of chronic nephritis with high protein diets and amino acids.

Dr. J. Abelin, Berne, Switzerland, $800 for a research on the influence of the vegetative nervous system on the metabolism.

As a rule, preference will be given to researches on a single problem or on closely allied problems: It is hoped that investigators in this and in other countries may be found, whose work on similar or related problems may be assisted so that more rapid progress may be made possible.

Applications for grants to be held during the year 1925–26 should be in the hands of the executive committee before May 15, and should be sent to the secretary, Dr. Francis W. Peabody, Boston City Hospital, Boston, Massachusetts.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM FRANCIS HILLEBRAND, chief chemist of the Bureau of Standards, died on February 7 at the age of seventy-one years.

THE nomination of Dr. William M. Jardine, president of the Kansas State Agricultural College, to be United States secretary of agriculture has been confirmed by the senate. F. D. Farrell, dean of the School of Agriculture, has been named acting president of the college, and Dr. Jardine has been given an indefinite leave of absence.

DR. W. W. KEEN, of Philadelphia, has been elected a foreign honorary member of the Royal Academy of Medicine of Belgium.

AT the graduation exercises of the Army Medical School on February 10, Captain Harvey R. Livesay was awarded the Sternberg Medal and Lieutenant Leon L. Gardner the Hoff Medal.

THE Geological Society of England has announced the distribution of its medals and awards for this year as follows: Wollaston Medal, G. W. Lamplugh; Murchison Medal, Dr. H. H. Thomas; Lyell Medal, J. F. N. Green; Bigsby Medal, C. W. Knight; Wollaston fund, Dr. A. Brammall; Murchison Fund, Dr. A. E. Trueman; Lyell Fund, Dr. J. A. Thomson and Dr. W. A. Richardson.

THE Italian association of hygiene is planning to present a gold medal to Dr. A. Sclavo, professor of hygiene at Florence, on the occasion of its annual meeting, in tribute to his services to the cause of hygiene in Italy.

PROFESSOR BOHUSLAV BRAUNER, professor of chemistry in the Charles' (Bohemian) University at Prague, has been awarded the cross of a chevalier of the French Légion d'Honneur for his scientific work in chemistry.

A DINNER was given at the Colonial Club, Cambridge, on February 3, in honor of Solon Irving Bailey, Phillips professor of astronomy, who retired from the staff of the college observatory on February 1, after thirty-two years of service.

DR. LEWIS BUCKLEY, of New York, has been elected chairman of the Engineering Foundation, New York.

PROFESSOR FREDERICK H. KRECKER, of Ohio State University, has been made editor of the *Journal of Science*, the official organ of the Academy of Science and of the Scientific Society of the University.

DR. FRANZ E. GELDENHUYS was recently named by the Minister of Agriculture in South Africa as chief of a new division of agricultural economics and markets in the Department of Agriculture.

EDWARD P. BARTLETT, associate professor of chemistry at Pomona College, California, is on a year's leave of absence from the college and has accepted an appointment in the Haber division of the Fixed Nitrogen Research Laboratory, Washington, D. C.

VANCE P. EDWARDES, in charge of sulphite investigations in the pulp and paper section of the Forest Products Laboratory, 1917–1921, has rejoined the laboratory after three and one half years in the employ of the Interlake Division of the Consolidated Water Power & Paper Co. at Appleton, Wis.

LEOPOLD R. CERECEDO has resigned as professor of chemistry at Fordham University, New York, to do research work at Yale University.

DR. E. V. COWDRY, of the Rockefeller Institute for Medical Research, who has been working in Sir Arnold Theiler's laboratory near Pretoria, South Africa, expects to arrive in New York early in March.

IT is reported that Mme. Curie, of France, has accepted the invitation of the National University, Mexico City, to deliver a series of lectures at the university on radium developments.

PROFESSOR E. V. MCCOLLUM, of the School of Hygiene and Public Health of the Johns Hopkins University, recently lectured at the Universities of Wisconsin, Minnesota, Iowa, Nebraska, the Mayo Foundation, the Academy of Medicine of Des Moines and at Washington University, St. Louis, on the subject of "The present status of our knowledge of vitamins."

DR. OSCAR M. SCHLOSS, professor of pediatrics at the Cornell University Medical College, will deliver the seventh Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, March 21.

His subject will be "The intestinal absorption of antigenic protein in infancy."

DR. THEOBALD SMITH, director of the department of animal pathology of the Rockefeller Institute, recently spoke at Cornell University on "The purpose of research."

DR. MICHAEL I. PUPIN, of Columbia University, delivered the midwinter convocation address at George Washington University, on the afternoon of February 23.

DR. J. PAUL GOODE, professor of geography in the University of Chicago, gave an illustrated lecture on "Hawaii: An island paradise," before the Geographic Society of Chicago, on February 27.

DR. GEORGE F. DICK, associate professor of clinical medicine at the University of Chicago, lectured on "Scarlet fever" at the School of Hygiene and Public Health at the Johns Hopkins University on January 26.

DR. S. DUSHMAN, of the General Electric Company, of Schenectady, gave two lectures at the Massachusetts Institute of Technology, on February 17 and 18, entitled "Recent aspects of Bohr's theory."

E. M. K. GEILING, of the Johns Hopkins University, addressed members of the Southern California section of the American Chemical Society at Los Angeles on January 28, on "The chemical and physiological properties of the secretions from internal glands."

DR. EMMELINE MOORE, investigator in fish culture for the New York State Conservation Commission, gave a lecture recently on the topic, "Stream pollution in relation to wild life conservation," before the class in conservation of wild life, department of zoology, Cornell University.

PROFESSOR MANNE SIEGBAHN, of the University of Upsala, Sweden, delivered a series of three lectures on "X-rays and atomic structure" at the California Institute of Technology, on February 6, 7 and 9.

SIR DANIEL HALL, of the British Ministry of Agriculture, gave two lectures at Cornell University on January 30, entitled, "The case of the large versus the small farm" and "Tulips: a study of the history and problems presented by a cultivated plant."

PROFESSOR PETER DEBYE, of the Federal Institute of Technology, Zürich, is giving a series of three lectures on "Theories of magnetism" in the Jefferson physical laboratory, Harvard University, on February 19, March 3 and 5.

C. J. P. CAVE delivered his presidential address to the Royal Meteorological Society, England, on January 21, on "The present position of meteorology and meteorological knowledge."

SIR WILLIAM B. HARDY delivered a lecture on "Problems presented by films on solid surfaces," under the auspices of the Chemical Society, London, on February 26.

FRIENDS and admirers of the late Angelo Mosso, the distinguished Italian physiologist, and for many years professor in the University of Turin, are planning a memorial. This will take the form of a monument in his native town, Chieri, and eventually an institution bearing the name of Mosso. Contributions are solicited by the committee and may be sent to Professor Edoardo Audenino at Turin.

A BRONZE portrait panel, erected to Dr. Isadore Dyer, formerly dean of the Tulane University Medical School, New Orleans, by the faculty of the school, was unveiled at a recent meeting of the Southern Medical Association.

THE brain of Dr. Burt Green Wilder, who died on January 21, has been bequeathed to Cornell University for scientific purposes. The collection of brains at Cornell, most of them prepared by Dr. Wilder when he taught there, is said to be one of the finest in the world.

PRESTON A. LAMBERT, professor of mathematics at Lehigh University, was drowned on February 15, aged sixty-three years.

DR. DUNLAP J. MCADAM, professor emeritus of mathematics at Washington and Jefferson College, died on February 15, aged eighty-two years.

DR. OLIVER HEAVISIDE, of England, known for his work in electromagnetism, died on February 5, in his seventy-fifth year.

PROFESSOR W. A. HASWELL, F.R.S., emeritus professor of biology in the University of Sydney, and author, with the late Professor T. Jeffrey Parker, of "A text book of zoology," has died, aged seventy years.

THE deaths are also announced of the following scientific men: Dr. E. Weber, professor of physiology at the University of Berlin; Dr. Alberto Segovia, emeritus professor of biology at Madrid; Dr. E. Hedinger, professor of anatomy at the University of Zürich; Dr. Leo Testut, emeritus professor of anatomy at the University of Lyon; Dr. A. Schnabel, of the Koch Institute at Berlin; Dr. Adolf Schenkl, emeritus professor of ophthalmology at Prague; Dr. Albert Narath, professor of surgery at the University of Utrecht, and Dr. Julius Hirshberg, professor of ophthalmology at the University of Berlin.

THE annual congress of Medical Education, Medical Licensure, Public Health and Hospitals will take place in the Congress Hotel, Chicago, from March 9 to 12. The program includes symposiums on "Twenty-five years' progress in medical education," "Medical service in rural communities," "Essentials of an adequate examination" and "Essential principles of a medical practice act."

THE 197th meeting of the Washington Academy of Sciences was a joint meeting with the affiliated societies of the biological group and was held on February 19. A group of papers was presented on "Undesirable immigrants" from the standpoints of "Animal diseases," by Dr. J. R. Moller, Bureau of Animal Industry; "Plant diseases and insect pests," Dr. C. L. Marlatt, Bureau of Entomology; "Human diseases," by Dr. Lawrence Kolb, Hygienic Laboratory.

THE new Sterling Hall of Medicine at Yale University was dedicated on February 23. The building was presented by George Hervey Church, representing the Sterling trustees, and was accepted for the university by President James Rowland Angell. Addresses were made by Dr. Harvey Cushing, professor of surgery at Harvard University, and by Dr. William Henry Welch, director of the School of Hygiene and Public Health at the Johns Hopkins University. Dean Milton C. Winternitz, of the School of Medicine, presided.

AT the recent meeting of the American Society of Biological Chemists held in Washington, D. C., from December 29 to 31, Dr. Henry C. Sherman, Columbia University, was elected president; Dr. Edward C. Kendall, Rochester, Minn., vice-president, and Dr. Walter R. Bloor, Rochester, N. Y., treasurer. The secretary is Dr. David W. Wilson, Philadelphia.

AT the annual meeting of the Association for Research in Nervous and Mental Diseases, held in the Hotel Commodore, New York, on December 29 and 30, Dr. Walter Timme, New York, was elected president; Dr. Edward W. Taylor, Boston, vice-president; Dr. Henry A. Riley, New York, secretary-treasurer, and Dr. Thomas K. Davis, New York, assistant secretary. The proceedings of this meeting, representing the results of the research under the auspices of the association, will be published and distributed to members without charge.

THE policy of the United States Forest Service to make research so far as possible a cooperative affair between scientist and layman was furthered February 12 and 13 with the first meetings in Asheville, North Carolina, of the Appalachian Forest Research Council, a group of local men of affairs appointed by the secretary of agriculture to assist the Appalachian Forest Experiment Station with cooperation and advice on all forestry matters touching the welfare of this region. Two days were devoted to meetings, under the chairmanship of Mr. W. D. Tyler, president of the Clinchfield Coal Corporation, of Dante, Virginia. Those present showed their interest in the work of the council in the adoption of a strong series of resolutions supporting state and federal action towards forest tax adjustment, state forestry, fire protection, utilization of timber killed by the chestnut blight and cooperation with the experiment station.

ON January 3, Pi Chapter, of Phi Sigma Biological Research Society, was installed at Emory University, Atlanta, Georgia, by the president, Dr. Ira E. Cutler, head of the biology department of the University of Denver.

TEN medical officials of Central and South America, comprising the next interchange of public health officials by the League of Nations, have been invited by Surgeon General Cumming to spend two months in the United States studying health conditions in various parts of the country, according to the New York *Times*. Before coming to the United States, the officials, who represent Argentina, Brazil, Cuba, Costa Rica, Mexico, Paraguay, Peru, Salvador, Uruguay and Venezuela, will meet in Havana to spend a week studying measures against epidemic diseases in Cuba.

ACCORDING to press dispatches two human skeletons belonging to the Paleolithic Age, of the Neanderthal type, and believed to be more than 50,000 years old, have been discovered in a cave near Simferopol, in the Crimea, by Professor Bontish-Osmolovsky, a Russian anthropologist. While the two skeletons are not anything like the age of the skull of the man-like ape, recently discovered by Professor Dart, near Bechuanaland, anthropological authorities here say that the Simferopol finds, taken altogether, throw considerable light on the remote primeval period. In addition to the human relics found in the cave, there were also discovered a number of skeletons of mammoths, dinosaurs, cave hyenas, cave bears and a large variety of stone implements.

THE establishment of an astronomical observatory with a large telescope in Honolulu is assured, according to an announcement made there recently by T. S. H. Shearman, head of the Weather Bureau in Vancouver, who went there to take up the matter with officials of the Pan-Pacific Research Institution. Mr. Shearman is the builder of the large telescope placed in the Frye Observatory in Seattle. The original plans called for it to be established in Honolulu, but the outbreak of the war in 1914 brought about a change. Mr. Shearman said that a four-foot reflector telescope would be installed in Honolulu at once,

and if the Hawaiian skies prove satisfactory as an observing area, it will be replaced by a ten-foot reflector, similar to the one in Seattle.

A PROSPECTUS has been issued by the New York University describing a proposition to establish a national institute for research in colloid chemistry. In this pamphlet Professor J. H. Matthews outlines the need for such an institution and sets forth definite plans for the project, and presents the views on the subject of many leaders in this field.

ALONG the lines of the American national parks, such as the Yellowstone, an Albert National Park will be established in the Belgian Congo, according to a decision reached between the King and the Minister of the Colonies. A royal decree will be issued in the near future forbidding hunters to penetrate the zone selected, which is in the northeast portion of the Belgian Congo, at an altitude of 3,000 to 4,000 meters between Lake Kuon and Uganda. Flora and wild animals will be protected by the government.

THE Minister of the Colonies, by a decree dated December 30, has created a large game sanctuary in France's Antarctic possessions. These possessions include the islands of Crozet, St. Paul and Amsterdam, Adelia Land, and the Antarctic coast between Doigt de Sainte Anne and Port aux Lapins. The principal animals protected are polar bears, walrus, sea lions and penguins. The French naval station in Madagascar will be responsible for the patrol of the new preserve.

ACCORDING to press dispatches, Great Britain intends to enter the air race to the North Pole with an expedition next May under the leadership of a young Icelander, Grettir Algarsson, and Captain Frank Worsley, who commanded Shackleton's ships, the *Endurance* and the *Quest*, in their explorations of south polar regions. It will proceed to Spitzbergen, then north as far as the ice will permit and establish a base somewhere 81°. The final six-hundred-mile air dash to the pole will be made by Algarsson and one companion in a special seaplane fitted with skis and floats.

UNIVERSITY AND EDUCATIONAL NOTES

SIMON GUGGENHEIM, former United States Senator from Colorado, and his wife have given $3,000,000 for the endowment of the John Simon Guggenheim Memorial Foundation Fellowships for advanced study abroad.

THE Commonwealth Fund, of New York, has announced the establishment of twenty annual fellowships for British students at American universities, similar to the Rhodes scholarships for American students.

ANNOUNCEMENT has been made of the completion of the $3,000,000 fund for the establishment of the Wilmer Institute of Ophthalmology at the Johns Hopkins University Medical School. Dr. William Holland Wilmer will be at the head of the institute and professor of ophthalmology in the Johns Hopkins Medical School.

T. R. FERENS, formerly a member of British Parliament, has given the sum of £250,000 as a nucleus of a fund for the founding of a university college in Hull, England.

THE board of regents of the University of Nebraska has elected Dr. J. Jay Keegan, now professor of clinical pathology, dean of the School of Medicine to succeed Dr. Irving S. Cutter, resigned.

DR. PAUL F. SHARP, of the Montana Agricultural Experiment Station, has been appointed professor of dairy chemistry in the department of dairy industry at Cornell University.

DR. ERNEST C. LEVY, chief health officer of Richmond, Va., and director of public welfare, has accepted the professorship in preventive medicine at the Medical College of Virginia, Richmond.

CARL OTTO, formerly of the University of Cincinnati, has been appointed assistant professor in the department of chemistry and chemical engineering at the University of Maine.

DR. EDWARD HINDLE, professor of biology in the Cairo School of Medicine, has been appointed a member of the London School of Hygiene and Tropical Medicine, to undertake research work in spirochaetosis.

PROFESSOR O. VOGT, director of the Institute for Research on the Brain, Berlin, has been appointed emeritus professor of the University of Oporto, Portugal, where he recently delivered a course of lectures.

PROFESSOR GUSTAV HERGLOTZ, of the University of Leipzig, has been called to the chair of mathematics at the University of Göttingen to take the place of Professor Runge, who has been made emeritus professor.

DISCUSSION AND CORRESPONDENCE

THE ZOOLOGICAL RECORD AND BIOLOGICAL ABSTRACTS

MANY zoologists in this country will be interested in the presentation by Dr. P. Chalmers Mitchell, in a recent number of SCIENCE, of the present financial situation of the *Zoological Record*. This excellent publication has served us well since 1864 and American zoologists would be the last to contribute in any way to its harm. Indeed, the obligation due our British fellows is so great that only some positive efforts on our part to meet their needs can serve to

express our appreciation. In view of the regard in which the *Record* is held by American zoologists, it is a surprise to learn how small has been their contribution to its support. It is much to be hoped that Dr. Mitchell's statement of the case will be all that is required to call forth an appropriate response from those who profit by the labors of British zoologists in the field of bibliography.

The position taken by Dr. Mitchell with regard to the continuation of the *Record*, until it is demonstrated that the proposed *Biological Abstracts* system either is or is not sufficient to meet the needs of zoologists in this field, seems to me wise. During this period of trial, as I understood Dr. Mitchell, the material gathered for *Abstracts* could be drawn upon by the *Record*, effecting thereby some saving of time and expense. Certainly all effective avenues of cooperation should be utilized in the common aim to advance biology. In the end it may be demonstrated that the reference system in zoology, represented by the *Record*, is so distinctive a service, as compared with abstracts in biology, the field of the proposed *Biological Abstracts*, that it should be continued, modified or unmodified as circumstances dictated. Should this be the case, and if meanwhile through cordial and sympathetic cooperation between American biologists and their fellows abroad, there should establish itself the ideal of a world's service in biological abstracts, the obligation to support the *Record* would be all the more insistent on American biologists.

It is unfortunately true, however, that even in respect to reference systems in zoology the American worker faces a divided responsibility, because he has given both a sentimental and a financial encouragement to the Concilium Bibliographicum and, at the present time, is responsible for its support through the National Research Council.

The thought would naturally suggest itself that if the two types of services are to be concurrent, there might be, during the period of trial, a delimitation of fields to prevent overlapping. This has been considered as a principle during the five years in which plans have been maturing for *Biological Abstracts* and the conclusion reached, especially emphasized by experience with *Botanical Abstracts*, that it is increasingly difficult to subdivide biology, even along the broad lines of plant and animal sciences. In this particular case there is the further difficulty that the *Record* is a reference system while the new plans are for abstracts. Then there is the very important practical consideration that the Union of American Biological Societies, which has assumed financial responsibility for the new venture, expects the service to be complete and will support it through individual subscriptions to the degree in which it represents the varied aspects of biology. While the Rockefeller Foundation has generously subsidized the editorial features of the enterprise, the costs of manufacture and distribution must be paid by subscriptions. Recognizing our more fortunate present financial condition, the union has counted upon carrying this alone and has asked nothing from the biologists of other countries. Financial responsibility may, therefore, dictate some courses which otherwise might be debatable.

In this incidental discussion of abstracts. Dr. Mitchell raises some questions which have given much concern to those who have made a most intimate study of the problems involved in a complete world service of this character. How can you be sure that no worthy articles are omitted, how can the service be administered so as to meet the varied and varying needs of different groups, and how can the accumulated material be made completely available to all who may be interested? There are, of course, no easy answers to these questions—the easy things do not trouble us. Briefly, it may be said that the conclusion reached by us with regard to the character and scope of such an inclusive project was that determination on these matters could be made only by those most interested and competent. We came to the conclusion that the workers of no one country could do justice in abstracting to those of other countries, therefore we are inviting the intimate cooperation of other nationalities to the end that they may see that all worthy national products become international in their distribution through a common abstracting medium. We did not feel that specialists in one field of endeavor could determine the form or character of the material which would best serve those in another and accordingly have asked the constituent members of the union to name committees on cooperation to which could be referred questions of a special or technical nature. The particular instance mentioned by Dr. Mitchell is an excellent example of this form of problem. No one but a taxonomist is in a position to say what form of abstract will serve him best, and apparently an ornithologist does not desire an entomologist to speak for him in this matter. The best we can do is to ask the organized groups, which have crystallized by natural affinities out of the biological mass, to determine the form and extent of representation to be accorded their subjects. Finally, it will have to be determined how far, in the interests of all, the desires of the few can be met.

No one who has given much thought to the matter is inclined to minimize the difficulties involved in inaugurating and conducting such an enterprise as an international biological abstracts service. It has, however, now become a necessity and must be pro-

vided if we are to keep within measurable distance of the chemists and other groups, who have been more wise than we are. The difficulties can be met and a tremendous impetus given to biology by a cordial, frank and sympathetic study of the problem and by effective and whole-hearted cooperation in carrying out its solution.

American biologists have established a working organization by combining the forces of more than twenty national societies into a single union. With the help of the National Research Council, this union has sought and found financial support for editorial expenses and has assurances from its members of subscriptions to help pay for manufacture and distribution costs. It has made a five-year study of abstracting problems, and through the successful conduct of *Botanical Abstracts, Bacteriological Abstracts, Endocrinology* and other partial services has developed experience and a trained personnel in this field of bibliography. Through the "Bibliographic Service" of the Wistar Institute the animal biologists of the country have had seven years' experience in the preparation of authors' abstracts. All these things are brought as contributions toward the establishment of what seems to be the most necessary publication agency as yet unprovided.

In return we ask that our fellow-workers abroad join with us in planning and operating a biological abstracting service which will truly represent the world's contributions in all branches of the subject, and which will serve, in the largest measure, to make our bibliographic labors easy and effective. To that end we have invited the appointment of foreign representatives who will work directly with the committee provided by the union and the National Research Council. We sincerely hope our English friends will accept our invitation in the spirit of service which prompts it.

C. E. McCLUNG

UNIVERSITY OF PENNSYLVANIA

I HAVE just read with much interest the brief article by Dr. P. Chalmers Mitchell on "Abstracts and the *Zoological Record*," published in SCIENCE for January 16.

It has been a great regret to zoologists the world over that the *Zoological Record* has had difficulty in meeting the cost of publication.

The *Record* is indispensable to workers in zoology and discontinuance of, or serious delay in, its publication, would prove a serious handicap.

It is noted that something over £150, a ridiculously small amount, have been contributed by American institutions and individuals to help tide the *Record* over the period of deficit. The California Academy of Sciences was glad to contribute to this fund. It is hoped that many other institutions will do likewise and thus insure the uninterrupted continuance of this necessary publication.

BARTON WARREN EVERMANN

SAN FRANCISCO, CALIFORNIA

The following resolution was passed unanimously by a thoroughly representative meeting of British zoologists held in the rooms of the Zoological Society of London on January 10:

This meeting of British zoologists is of opinion that it is in the highest degree desirable that an effort should be made to extend the system of publishing comprehensive abstracts of zoological literature, and we desire to place on record our great appreciation of the work that has been done to this end by the American Committee for *Biological Abstracts*.

We are, however, also of opinion that the scheme that has recently been submitted for our approval is open to serious objection in various directions. Only some of these need here be mentioned, *viz.*:

(1) The magnitude of the work involved appears to have been underestimated.

(2) The financial arrangements so far made public are obviously quite inadequate for the purpose, which is a most serious point; it would be folly to assume that any publication of abstracts in pure science can be made self-supporting, and no scheme of this kind should be put into operation until satisfactory arrangements have been made for some permanent endowment.

(3) The proposal to publish the abstracts of the whole of biological literature in a single journal is unsatisfactory; such a journal would be extremely cumbersome and highly inconvenient for all classes of workers. Bearing in mind the probable great increase of literature in the future, a much sounder plan would be to institute separate journals dealing with convenient sections of scientific work.

(4) The abstracts will be very much shorter than those now being published in this country, and this brevity will seriously detract from their value to most workers.

(5) The estimates for indexing are entirely inadequate.

(6) No provision has been made for the utilization or coordination of the various biological abstracting organizations that already exist in this country and deal adequately with several branches of science; apparently it is proposed to reduplicate their work, but in a less useful form.

In the circumstances we consider that this scheme requires drastic revision.

FRANK BALFOUR BROWNE

UNIVERSITY OF CAMBRIDGE

LOUIS AGASSIZ AND "DARWINISM"

SOME persons to whom I have told the following incident have advised me to publish it, but until now

I have refrained from doing so, because I knew of the matter only at second hand, and as I made no notes at the time, I can not quote exactly, but only in substance. I had recently a conversation with Professor A. H. Tuttle, for many years at the University of Virginia, and our discussion led to mention of the position of Louis Agassiz upon evolution. Professor Tuttle in his early years went to Harvard to study with the late Jeffries Wyman, and, one day, as he was talking with the doctor, Tuttle mentioned Agassiz' opposition to the theory. He has kindly written out his recollections of what Wyman said and which he has permitted me to quote.

The following is a statement, as accurately as I can, after repeated and careful effort, recall it, of the incident of which I told you. The words of Agassiz surprised me so much that they were especially impressed on my memory, and I am sure that they are here given substantially as I received them. Of the accuracy with which they were quoted by Wyman no one who ever knew him could have any question.

It was my good fortune to be (1870–72) a student in the laboratory of Jeffries Wyman. He was not only a colleague of Agassiz, but also his neighbor and one of his most intimate friends. In those days "Darwinism" was a very live subject. I had read every thing that Agassiz had published which bore upon it. One day I asked a question about his violent opposition to it of Professor Wyman.

In reply he told me that at first they had discussed the subject quite freely; at the last time it was mentioned, after his statement of some considerations based upon his own personal work then in hand, Professor Agassiz exclaimed:

"Wyman, if I were a comparative anatomist, as you are, I should probably think as you do. But I can not accept this new doctrine consistently with the views that I have already put forth [referring, of course to his "Essay on classification"] and I do not intend to!"

"After that," added Professor Wyman, "of course neither of us said anything more about it to the other."

In one of my many talks with the late Professor A. S. Packard, who studied for several years with Agassiz and who always remained intimate with him, he told me that Professor Agassiz, in the last year of his life, said (I quote only the substance, not the exact words): "The greatest mistake of my scientific life has been in fighting the theory of evolution. I saw that it was coming for years and my 'Essay on classification' was written largely to forestall it. I believed it all wrong, but now I see that it will prevail."

This, of course, is merely my recollection of a conversation some forty years ago, but it made such an impression on me that I am confident that I have the substance correctly.

J. S. KINGSLEY

BERKELEY, CALIFORNIA

NEW ORLEANS AND YELLOW FEVER

I NOTICE on page 14 of the November 14 issue of SCIENCE, the last statement began, "About a month ago a case of yellow fever was reported in New Orleans without causing a ripple of interest in the medical profession."

While I fully endorse the sentiment expressed in the entire article, which I know is written in accord with the modern conception of preventive medicine, nevertheless, I thought it advisable to call your attention to the fact that this case of yellow fever was not reported in New Orleans. The patient, a Mexican, passed through New Orleans from Mexico and stopped for about two days. We were advised of the diagnosis of yellow fever eight days after he had left the city and had died in Houston, Texas. Without going into details, I am reliably informed that the U. S. Public Health Service has since considered the diagnosis of yellow fever erroneous.

New Orleans has not had a local case of yellow fever since 1905; a few isolated cases since that time have all been cases coming up through quarantine.

E. L. LECKERT

DEPARTMENT OF PUBLIC HEALTH,
NEW ORLEANS, LOUISIANA

SCIENTIFIC BOOKS

Helmholtz's Treatise on Physiological Optics, translated from the third German edition. Edited by JAMES P. C. SOUTHALL, professor of physics in Columbia University. Published by the Optical Society of America. 1924. Volume I. The Anatomy and Dioptrics of the Eye. (pp. xxiv + 482).

THIS is the first volume of the English translation of Helmholtz's great and original work on physiological optics. It is not merely a reproduction of Helmholtz's own epoch-making treatise on this subject, but it is a translation of the famous third edition published in Germany between 1909 and 1911 long after Helmholtz's death, under the auspices of the late Professor W. Nagel, in collaboration with Professor A. Gullstrand and Professor J. v. Kries. This edition, brought up to date at that time and enriched by the contributions of these new editors, was expanded into a work published in three large volumes, which comprised perhaps more than double the contents of the original. The English edition also contains some additional new material written by Professor Gullstrand and Professor v. Kries, an article by Dr. Christine Ladd-Franklin and various notes and compilations made by the editor and his collaborators. Thus, for example, the first volume on "The Anatomy and Dioptrics of the Eye," which is the special vol-

ume here under discussion, contains an entirely new chapter on ophthalmoscopy by Professor Gullstrand, which was not in the third German edition at all. Professor Gullstrand himself has designed an ophthalmoscope which is a marvel of optical perfection and many other notable ophthalmic instruments besides. Doubtless, many persons are accustomed to think of anatomy as practically a closed subject, so far at least as the human body is concerned; but a reader who will glance at the partial list of more recent bibliography on the anatomy of the eye, compiled by Dr. Davenport Hooker for the English edition, which comprises more than seven pages of fine print in this first volume, will have ample evidence to the contrary.

Apart from Helmholtz's own masterful treatment of the complex problems connected with the dioptrics of the eye (including such subjects as ophthalmometry, corneal astigmatism, chromatic and spherical aberrations, mechanism of accommodation, ophthalmoscopy, etc., in all of which he was the great pioneer), undoubtedly the main value of this volume is to be found in Gullstrand's discussion of these matters from the standpoint of his modern theories of optical imagery. Here he is the acknowledged authority at the present time. The only detailed account of his researches and determinations of the schematic eye which have ever been published in English appears in these pages; together with his articles on refraction, mechanism of accommodation, spherical aberrations, etc. For this reason, if for no other, this particular volume should be of literally incalculable value to scientific ophthalmologists both in this country and in England, and indeed to oculists and optometrists generally.

The Optical Society of America certainly deserves much credit for bringing out this translation of the definitive edition of the "Handbuch der physiologische Optik." The English scientific world should be grateful especially to Mr. Adolph Lomb, because, as the editor states in his preface, without his "continual advice and encouragement" the great undertaking could never have been brought to successful completion.

The second volume, on "The Sensations of Vision," which is now ready also, contains 480 pages. The third volume, on "The Perceptions of Vision," which is still in preparation, will be about double the size of either of the other two.

The book is not on sale at the regular booksellers. Orders should be sent to Professor F. K. Richtmyer, secretary of the Optical Society, Cornell University, Ithaca, N. Y., or to the Columbia University Bookstore, 2960 Broadway, New York City.

S.

SPECIAL ARTICLES

THE ELECTRICAL CHARGES OF LIVING CELLS

IN a recent paper[1] evidence was presented to show that the particles in the interior of living cells bear a positive charge, whereas the particles in the surface layer have a negative charge. The evidence depended in part on the observed fact that Ca and Mg ions tended to make the interior protoplasm more fluid, and that an excess of K, Na or NH_4 ions had the opposite effect. Bivalent ions are adsorbed more readily than monovalent ions, hence Ca and Mg ions furnish a greater positive charge to the colloidal materials (granules, oil-droplets or ultramicroscopic particles) in the interior of protoplasm. This would tend to produce coagulation if the normal charge were negative, but it would have the opposite effect if the normal charge were positive. The observed increase in fluidity when protoplasm is exposed to solutions in which the ratio of Ca or Mg ions is increased indicates a positive charge on the materials present in the interior of the cell. If this reasoning is correct, it is to be expected that trivalent cations should have an even more pronounced effect than bivalent cations like Ca and Mg.

It is hard to work with trivalent cations. Earlier experiments with aluminum chloride on sea-urchin eggs failed to yield results, for it was not found possible to separate the effect of the Al ion from the effect of the H ion always present in a solution of aluminum chloride in sea water. Neutralization of this acidity leads to a precipitation, until there is presumably no more Al ion left in solution. However, by adding small amounts of aluminum chloride to solutions of sodium chloride (in the absence of Ca), it was found possible to obtain solutions containing aluminum which were so near neutrality that the H ion could have no possible effect on the protoplasm. Under these conditions it was found that the aluminum, and presumably the Al ion, acts like the Ca ion, except that its action is at least a thousand times as strong. This is entirely in accord with expectation. Very dilute solutions of aluminum chloride (*e.g.*, m/25000) cause a pronounced liquefaction of the protoplasm in the interior of the cell. Ce ions act like Al ions, but they do not act in as great dilution.

With somewhat higher concentrations of Al or Ce ions, and even in some instances with Ca ions in the absence of all other cations, the adsorption of the cation at the surface of the cell is so great that the normal negative charge at the surface layer is apparently neutralized. As the surface membrane of the cell approaches an isoelectric condition, it be-

[1] Heilbrunn, 1923, *Amer. Jour. Physiol.*, LXIV, 481.

comes increasingly more brittle and is very easily injured. The sign of the charge at the surface may also be reversed, and such reversal appears to be accompanied by a visible swelling of the surface layer. At the same time the interior protoplasm becomes coagulated.

There is a decided variation in the behavior of sea-urchin eggs from day to day. This was at first very puzzling, for under apparently identical conditions the phenomena associated with reversal of surface charge sometimes occurred and sometimes failed to occur. Undoubtedly the charge at the surface of the cell is greater under certain conditions than under others. When sea-urchin egg cells are taken directly from the ovary, the charge at the surface appears to be greater than when the cells are washed in sea water. The difference is marked and it is believed to be due to a greater concentration of HCO_3 or CO_3 ions at the surface of the unwashed eggs. Washing the eggs lowers the concentration of carbonic acid in the sea water surrounding them. This disturbs the carbonate equilibrium and results in a loss of HCO_3 or CO_3 ions from the cell surface. The result is a decrease in the surface negative charge.

Indeed, it seems certain that one source of the charge at the surface of living cells is the diffusion of carbonic acid. Many years ago Ostwald[2] showed that when a semipermeable membrane hinders the passage of certain ions as compared to others, the membrane becomes the seat of an electric charge. There are reasons for assuming that the HCO_3 and CO_3 ions diffuse more readily through the surface membranes of cells than the H ion. If this is true then the exterior of living cells would of necessity always be negative, and this negative charge would be greater the greater the amount of carbonic acid being given off.

On the basis of this view, since we know that during activity of the cell there is a large increase in carbon dioxide production, it is easy to understand why the surface of active protoplasm should be electrically negative as compared with the surface of relatively inactive protoplasm. We are therefore led to a very simple explanation of the action current.

It is hoped to further develop these views and their applications in a more extended paper now in course of preparation.

L. V. HEILBRUNN

UNIVERSITY OF MICHIGAN

DIFFERENTIAL TILTING OF THE CONTINENTAL SHELF OFF THE ATLANTIC COAST OF NORTH AMERICA

RECENT studies of submarine profiles off the Atlantic coast from Florida to Nantucket reveal interesting facts regarding the depth of the outer margin of the continental shelf from Florida northward. Hydrographic charts of this area show that the continental shelf, or submerged portion of the coastal plain, which off southern Florida is only a few miles wide, broadens off the Carolinas and Virginia to 50 to 80 miles, reaches a breadth of 100 miles off northern New Jersey and 150 miles or more off the coast of Maine. The emerged portion of the coastal plain, on the contrary, is broad at the south and narrows toward the northeast until it disappears in the vicinity of Long Island. These facts clearly suggest a progressively greater submergence of the Atlantic coast toward the northeast, emergence toward the southwest, or both.

Projected profiles showing the average form of the sea floor for belts 10 to 15 miles broad were made at frequent intervals along the coast across the continuous shelf adjacent to the continent, not including the Bahama Banks or the second shelf known to occur at great depths farther to the eastward. In a number of cases the margin of the shelf appears rounded or irregular, and the precise position of the edge of the shelf is somewhat difficult to determine. A basis for comparison of the relative positions of the shelf edge was obtained by projecting seaward the normal surface slope of the continental shelf, as shown on the profiles some distance back from the rounded or ragged margin, until it intersects a similar upward projection of the scarp face. These intersections, although not indicating the precise position of the edge of the shelf, may be assumed to vary in elevation about as the edge of the shelf varies. On studying the position of these intersections in various profiles, it was found that they show a progressive increase in depth from Florida northward, as given in the accompanying table. The depths from Nantucket northeastward were obtained from profiles drawn by M. A. Stolfus.

Approximate Relative Depths below Sealevel of Edge of Continental Shelf from the Banks to Florida

Origin and direction of profiled belt	Depth of intersection of shelf surface and scarp in fathoms
From Grand Manan Channel, s.	68
" Cutler, Me., s.	64
" Great Wass Island, Me., s.	60–62
" Dyers Bay, Me., s.	64
" Mt. Desert Island, s.	68
" Isle-au-Haut, Me., s.	66
" Vinalhaven Island, Me., s.	71
" Tenant Harbor, Me., s.	70
" Portland, Me., s.	68
" Nantucket Island, s.s.e.	54
" Martha's Vineyard, s.	54
" Sagg and Wainscott, L. I., s.s.e.	47
" Shinnecock Bay, L. I., s.s.e.	50

[2] Ostwald, 1890, *Zeitschr. f. physik. Chem.*, VI, 71.

Approximate Relative Depths below Sealevel of Edge of Continental Shelf from the Banks of Florida (Cont.)

Origin and direction of profiled belt	Depth of intersection of shelf surface and scarp in fathoms
From Beach Haven, N. J., s.e.	52
" Intersection of 39° N.–73° 30′ W. e.s.e.	48
" Atlantic City, s.e.	53
" Wildwood, Cape May, N. J., s.e.	50
" Chincoteague Bay, Md., e.s.e.	42
" Fishing Pt., Md., e.s.e.	44
" Cedar Id., Md., e.s.e.	48
" Cobb's Id., Md., e.s.e.	40
" False Cape, e.n.e.	25
" Line of soundings e. from Currituck Sd. Light	20
" Roanoke Id., n.e.	25
" Long Shoal Pt., Pamlico Sd., e.	30
" Cape Hatteras, s.e.	18
" Portsmouth Id., s.s.e.	30
" Cape Lookout, s.s.e.	30
" Stump Sound, s.e.	30–36
" Cape Fear, s.s.e.	30
" Little River, s.s.e.	30
" Cape Romain, s.e.	24
" Charleston, S. C., s.e.	25
" St. Helena Id. (Beaufort) s.e.	28
" Savannah, s.e.	30
" St. Simon Sound, e.s.e.	27
" Pablo Beach, Fla., e.	24
" Halifax R. (Daytona) n.e.	25
" False Cape, Fla., n.e.	27
" Sebastian, Fla., n.e.	21
" Stuart, n.e.	15
" Card Sound, s.e.	3½
" Up Matecumbe Key, s.s.e.	4
" Vaca and Fat Deer Keys, s.s.e.	3

It will appear from this table that the margin of the Atlantic continental shelf, which, in the region of southern Florida, is only a few fathoms below sea level, is from 25 to 35 fathoms deep off Georgia and the Carolinas, 40 to 48 fathoms opposite Maryland, 48 to 55 off the New Jersey and Long Island coasts, and 60 to 70 fathoms deep at the outer edge of the Banks. This increase in depth confirms in a striking manner the differential tilting of the continent suggested by the broadening of the continental shelf and the narrowing of the coastal plain. It also confirms the conclusions reached by Johnson and Stolfus in a paper on "The submerged coastal plain and oldland of New England," appearing in SCIENCE for March 28, 1924. In this article submergence progressively greater toward the north was proved by the presence of the cuesta and inner lowland wholly submerged beneath the waters of the Gulf of Maine, whereas these forms are found above sea level farther south.

These observations indicate that the margin of the shelf certainly pays scant attention to the 100-fathom depth at which it is traditionally supposed to occur, and give no support to the theory that wave base is found at the same depth.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

GEOGRAPHICAL SOCIETIES AT THE WASHINGTON MEETING

(A report for Section E appeared in Science for February 6.)

The Association of American Geographers

President, Curtis F. Marbut.
Secretary, Chas. C. Colby.

(Report by the Secretary)

The twenty-first annual meeting of the Association of American Geographers reached the high-water mark both in the number of papers presented and in attendance. Forty-five papers were presented and five were read by title. Nearly 40 per cent. of the membership of one hundred and thirty-five and others to the number of approximately one hundred were in attendance at the sessions, which spread over three days and included six regular sessions, an evening round table, and a joint dinner with Section E of the A. A. A. S. The meeting was characterized by the general excellence of the papers, by active and discerning discussion and by the fact that the program proceeded according to schedule throughout. As a cross-section of productive scholarship in geography in America, the meeting indicates that important progress is being made in several aspects of the subject, and particularly as to the critical issues in economic and regional geography. Interest at the meeting centered in the special sessions devoted to tropical geography. Thirteen papers dealing with tropical problems were presented at the Wednesday morning and afternoon sessions and they constituted the basis for a round-table discussion in the evening. The papers covered problems of widely divergent character and were particularly virile because at least nine of them resulted from recent field work in the tropics. That economic development in many tropical areas is handicapped by the rainfall régime was pointed out by S. S. Visher, of the University of Indiana, and "An example of local variation of tropical climate" was discussed by J. Russell Smith, of Columbia University. Regional studies in Honduras and in western Ecuador were presented, respectively, by Nels

A. Bengston, of the University of Nebraska, and Hugh H. Bennett, of the U. S. Bureau of Soils. In a detailed study of the coconut industry in Trinidad, Preston E. James, of the University of Michigan, showed that the general trend toward closer adjustment of this industry to the natural environment is retarded by the planting of coconut estates in sections of the island not well suited to their culture. The problems connected with the further utilization of tropical areas were discussed for East Africa by H. L. Shantz, recently returned from that region, and for the Amazon Valley by Curtis F. Marbut, whose paper likewise was based on field experiences. Changes in routing of tropical products to American markets and the importance of market organizations and transportation facilities in the development of tropical areas on a commercial basis were illustrated by excellent papers of distinctive geographic quality by Helen M. Strong and E. S. Gregg, both of the U. S. Bureau of Foreign and Domestic Commerce. H. N. Whitford, of the same bureau, in a paper on "Geographic aspects of the production and consumption of rubber," traced the world movement of rubber from its primary markets to the various consuming centers. The interest of geographers in industrial and commercial situations and problems was illustrated by a series of papers presented at the Tuesday afternoon session. W. D. Collins, of the U. S. Geological Survey, reported upon work he is carrying forward on the relations between quality of water and industrial development in certain sections of eastern United States. Esther Anderson, of the University of Nebraska, presented a geographic survey of the beet sugar industry of Nebraska. A. E. Waller, of Ohio State University, read a paper entitled "The dams of the Miami conservancy and the vegetation of their slopes." G. B. Roorbach, of Harvard University, analyzed briefly the relation of foreign trade to present-day New England. Glenn T. Trewartha's paper on "The dairy industry of Wisconsin as an adjustment to the natural environment" displayed a gratifying directness of analysis by proceeding at once to the phenomenon to be explained, *i.e.*, the dairy industry, rather than delaying with the time-honored prologue of topography, climate, etc., which has frequently befogged the issue in such studies. Richard Hartshorne, of the University of Minnesota, summarized the conclusions of an extensive monograph recently completed by him on "The significance of lake transportation to the grain traffic of Chicago." At the joint evening session with Section E of the American Association for the Advancement of Science, President Curtis F. Marbut, of this association, delivered a scholarly address on "The promulgation, decline and renaissance of Malthusianism and its relation to the character and geographic distribution of the soil," and Nevin M. Fenneman, retiring vice-president for Section E, presented an exceptionally interesting discussion under the title, "A classification of natural resources." Cartography was represented on the program by J. Paul Goode, who reported the progress in cartography being made in Poland, and by E. L. Stevenson, who showed how certain erroneous interpretations of the new world, current in the early years of transoceanic discovery, were recorded in the work of the early cartographers. One session was devoted primarily to papers of a physiographic nature, among which was a study notable for its refinement of analysis, presented by H. A. Marmer, of the U. S. Coast and Geodetic Survey, under the title "Mean sea level and its variation." Also in this group were a study of the glacial features in Evolution Basin by F. E. Matthes, of the U. S. Geological Survey, and a report of the discovery of Aniakchak Crater in Alaska by R. H. Sargent, of the U. S. Geological Survey. A discussion of the "Physiographic stages in the evolution of the San Juan Mountain region and their correlation with the physiography of the front ranges of Colorado," was presented by W. W. Atwood, of Clark University. The world-wide scope and divergent nature of the investigations being carried forward by the staff of the National Geographic Society, who were hosts for this meeting, was outlined by Gilbert H. Grosvenor, president of the society, and was evidenced by papers presented by three other members of the permanent staff of the society. Among papers that do not fall in the foregoing classifications, that of William H. Haas, of Northwestern University, on "The American Indian and geographic studies," was significant because it directed attention to the opportunity for geographical research in that field. Mark Jefferson, of the Michigan State Normal College, in a highly original thesis entitled "Malthus in the light of subsequent events." showed that the fears of Malthus that the world would become overpopulated have not been confirmed by the statistics of the ensuing one hundred and twenty years; the conclusion was reached that there is little likelihood that the world will ever be really crowded. A highly significant analysis of the future of Alaska, which was the last work of Alfred H. Brooks before his death last November, was read by his colleague in the U. S. Geological Survey, R. H. Sargent.

Important progress in the theory and technique of geographic field work was disclosed by field maps exhibited and discussed by Wellington D. Jones, of the University of Chicago, and V. C. Finch, of the University of Wisconsin. These reports of progress manifest the increasing interest of geographers in detailed regional studies in which emphasis is placed on the relationship existing between the economic activities and the natural environment for the areas in question. Reporting for the committee on geographic

provinces, W. L. G. Joerg, of the American Geographical Society, discussed the lines of approach that have been followed in outstanding attempts to delineate various types of geographic divisions.

All the regular Washington sessions were held in the buildings of the National Geographic Society. The Association of Geographers is greatly indebted to President Gilbert H. Grosvenor and the members of the society staff for their hospitality which did much to insure the success of the meeting. The officers for 1925 are: *President,* R. H. Whitbeck, University of Wisconsin; *vice-president,* H. L. Shantz, U. S. Bureau of Plant Industry; *secretary,* Chas. C. Colby, University of Chicago; *treasurer,* V. C. Finch, University of Wisconsin; *editor,* Almon E. Parkins, George Peabody College for Teachers; *councilors,* George R. Mansfield (U. S. Geological Survey), Wellington D. Jones (University of Chicago), Oliver E. Baker (U. S. Bureau of Agricultural Economics), Ellsworth Huntington (Yale University) and Curtis F. Marbut (U. S. Bureau of Soils).

The National Council of Geography Teachers

President, W. R. McConnell, Miami University.
Secretary, George J. Miller, State Teachers College, Mankato, Minn.

(Report by George J. Miller)

Three sessions were held this year and each was characterized by strong addresses. The first session was devoted primarily to a discussion of geography as a social science in the junior high school and secondarily to a discussion of an illustrative type of detailed regional study. The distinctive contribution that geography has to make as a social science, and concrete illustrations of how the objectives of social science could be attained, were presented in the first paper. The inability of Dr. Rugg to attend and present his plan for a general social science course brought keen disappointment. The objectives of geographic instruction; the use of geographic principles in the study of cities, together with concrete illustrations; the organization of geographic material for teaching, and criteria for judging a geography text were the outstanding topics of the second session. The preliminary report of the committee to establish geography standards for the first six grades indicates that a very thorough study of the subject is in progress and that a final report of constructive value will be the outcome. The banquet and evening session marked the climax of a most eventful and profitable meeting, both from the standpoint of fellowship and from that of the character and interest of the discussion. For the first time in the history of the National Council the importance of "teacher training" for college and university instructors was ably presented and discussed. The grave need of giving such training to all who become university and college teachers and reasons why our higher institutions should recognize this need and provide adequate instruction was presented by Dr. Colby, of the University of Chicago. The presence of teachers—grade, high school, normal school, college, university—from widely scattered portions of the United States emphasized the national character of the council and contributed greatly to making the 1924 meeting one of the most successful in its ten years of existence. Dr. A. E. Parkins, of George Peabody College for Teachers, was elected president for 1925.

ZOOLOGICAL SOCIETIES AT THE WASHINGTON MEETING

(A report for Section F appeared in Science for February 6.)

The American Society of Zoologists

President, R. S. Harrison.
Secretary, W. C. Allee, University of Chicago, Chicago, Ill.

(Report by W. C. Allee and H. W. Rand)

The American Society of Zoologists held sessions for the general program of papers on the mornings of Monday, Tuesday and Wednesday, December 29 to 31, and also Monday and Tuesday afternoons. Wednesday afternoon a session was devoted to a symposium on "Sex determination and sex differentiation," the participants being as follows: J. H. Schaffner, of Ohio State University; C. B. Bridges, of Columbia University; A. F. Shull, of the University of Michigan; W. W. Swingle, of Yale University; C. R. Moore, of the University of Chicago. The last session of the zoologists occurred Thursday morning in joint meeting with the Ecological Society of America. The program included 14 papers on miscellaneous ecological subjects. The entire zoological program, exclusive of the joint ecological program and the symposium papers, included 89 papers distributed by subjects as follows: general and comparative physiology, 29; endocrinology, 9; cytology, 6; embryology, 7; comparative anatomy, 9; protozoology, 9, parasitology, 17; evolution, 2; science teaching, 1. The annual zoologists' dinner took place Wednesday evening at the Hotel Raleigh. The dinner address was delivered by the retiring president of the society, Professor M. F. Guyer, of the University of Wisconsin, on "Soma and germ." Monday evening, at the City Club, was held a conference initiated and arranged by H. S. Colton, on problems of teaching zoology, with particular reference to the aims of teaching in the elementary college course. The discussion was led by R. A. Budington, E. C. Conklin, A. F. Shull and C. P.

Sigerfoos. A dinner was arranged in conjunction with the conference. The zoological exhibits were accessibly and attractively arranged and received much attention. They included materials in the fields of histology, cytology, embryology, genetics, parasitology, physiology and economic biology. In addition to the purely scientific exhibits, various biological supply firms presented attractive and instructive exhibits of technical apparatus and materials.

The business meeting of the American Society of Zoologists followed the business session of Section F, American Association for the Advancement of Science, on Tuesday afternoon. Eighteen resignations from membership were received, caused in the majority of cases by dissatisfaction with the journal arrangements of the society. Twenty-eight active and 17 associate members were elected, making the present total membership 423. The following officers were elected: *President,* C. R. Stockard; *vice-president* (one year), C. R. Moore; *secretary* (three years), D. E. Minnich; *treasurer* (three years), L. B. Arey; *member of executive committee* (five years), R. G. Harrison; *representative in National Research Council* (three years), L. L. Woodruff; *for Board of Journal of Morphology* (three years), H. B. Ward, F. Payne and R. W. Hegner; *representatives in council, American Association for the Advancement of Science* (one year), H. S. Jennings and M. H. Jacobs; *representatives in council, Union of American Biological Societies,* F. R. Lillie and R. G. Harrison; *members of advisory editorial board, Biological Abstracts:* H. S. Pratt and G. K. Noble (taxonomy); D. H. Tennent (embryology), and M. H. Jacobs (general physiology). Collection of voluntary contributions from members to provide support for the organization expense of *Biological Abstracts* for 1925 (in addition to $20,000 available from the Rockefeller Foundation) was authorized to be made in cooperation with the Union of American Biological Societies; $5,000 more is needed. Minutes were adopted on the death of three members, William A. Locy, Alexander MacGillivray and George A. Piersol. A resolution was adopted favoring the oceanographic survey proposed by the U. S. Navy, provided the scientific program is worked out in conjunction with the National Research Council; also resolutions favoring the protection of breeding grounds of birds and fish and the protection of waterways, harbors, lakes and ocean shores from oil wastes. The society voted to separate the payment of dues from subscription to the Wistar Institute journals. The dues for the coming year were placed at $2.00, in an effort to protect and if possible build up the reserve fund. Under the new plan the Wistar Institute allows members of the society to subscribe for journals at special rates.

It was voted that the 1925 meeting should be held at New Haven, in connection with the dedication exercises of the Peabody Museum of Natural History, and that members of the society or of the Genetics Sections who desire to present or introduce papers at Kansas City in connection with the next annual meeting of the American Association for the Advancement of Science shall be given the same service as regards the publication of abstracts as will those who offer papers for the New Haven meeting.

To avoid the growing congestion of the program at the annual meetings the program rules were modified so as to read as follows:

> Papers shall be listed in their respective groups in the order received. Each active member is entitled to 15 minutes of the time of the society at the annual meeting, which he may use to present one or more papers personally, or he may use any or all of this time in introducing papers of non-members on the program. The society recognizes, however, the right of the Genetics Section to make its own program rules in conjunction with the Genetics Section of the Botanical Society of America.

Detailed proceedings were published in the *Anatomical Record* for January, 1925.

THE ENTOMOLOGICAL SOCIETY OF AMERICA

President, Charles W. Johnson.

Secretary-treasurer, C. L. Metcalf, University of Illinois, Urbana, Illinois.

(*Report by C. L. Metcalf*)

The nineteenth annual meeting opened on Monday afternoon and continued through Tuesday and Wednesday, in the armory of the Central High School. There were four half-day sessions for the presentation of contributions, the one on Tuesday afternoon being a joint session with the Ecological Society of America. About thirty-five scientific papers, dealing with the physiology, ecology, morphology, life-histories and classification of insects were presented. Attendance at the several sessions ranged from about 75 to 250. At the business session on Tuesday morning the following officers were elected for 1925: *President,* George A. Dean, Kansas State Agricultural College; *first vice-president,* Lawson Caesar, Ontario Agricultural College; *second vice-president,* Paul S. Welch, University of Michigan; *secretary-treasurer,* C. L. Metcalf, University of Illinois; *members of executive committee,* E. P. Felt, Glenn W. Herrick, E. C. Van Dyke, J. A. G. Rehn, F. E. Lutz, Edith M. Patch; *representatives in the council of the American Association for the Advancement of Science,* W. A. Riley and W. E. Britton. It was announced that the following had been elected to fellowship in the society: F. E. Blaisdell, H. A. Gossard, Clarence M. Weed, T. L. Casey, E. T. Cresson, Jr., W. C. O'Kane, W. E.